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Performance Comparison of Fused Image Transmission over Various Channel Schemes

Taranjit Kaur[1], Ashish Malhotra[2,]

Student, Dept. of E.C.E., DAVIET, Punjab Technical University, Jalandhar, Punjab, India

Assistant Professor, Dept. of ECE, DAVIET, Punjab Technical University, Jalandhar, Punjab, India

ABSTRACT: Image fusion is merging multiple source images of same scene together to form one image which is more suitable for human visual perception and computer processing. In this paper two types of fusion called Hybrid Fusion is used to improve overall PSNR value of the resultant image. This resultant image is transmitted over different noisy channels (AWGN, Rayleigh, Rician) by using different modulation techniques like BPSK,QPSK,128 PSK ,256 PSK.. This paper attempts to provide overall better results for transmitting fused image over a noisy channel. The performance of the algorithm is analyzed by using two parameters i.e BER and SER.

KEYWORDS: PCA(Principal Component Analysis),DWT(Discrete Wavelet Transform),PSNR(Peak Signal To Noise Ratio),MSE(Mean Square Error),AWGN(Additive White Gaussian Noise),BER(Bit Error Rate),SER(Symbol Error Rate).

I. INTRODUCTION

Image fusion is a way of merging relevant information from several images into a single image. The resultant fused image will be useful for computer processing task for e.g. Medical Imaging, Astronomy, Military, Remote Sensing. Image fusion takes information of interest from several images of same scene and integrates it into one useful image; information of interest varies with area under consideration. Hybrid fusion is a proper method for integration of similar sensor and multi-sensor images to develop an image with enhanced information using two different fusion i.e. PCA and DWT. this fused image is modulated and transmitted to transmitter system using different modulation techniques like BPSK, 128 PSK, 256 PSK. By applying different processes over this modulated signal it was first converted to time domain before adding guard interval and then transmitted over noisy channel. After channel selection noise is added in the system and data is transmitted to the receiver where signal is converted to frequency domain. Last step is to compare the performance in terms of BER and SER plots. The output of the proposed scheme gives better quality images compared to the individual techniques.

II. RELATED WORK

In [1] authors propose to study the impact of impulsive noise on image communication in Orthogonal Frequency Division Multiplexing (OFDM) based PLC. In [2] aim of the project is reduce the PAPR of transmitted OFDM signals, improve the transmitted image quality & The SPIHT coder is chosen as the source coding technique due to its flexibility of code rate and simplicity of designing optimal system. In [3] the work proposes optimal image transmission over coded OFDM system with Low Density Parity Check Coding. They tried to improve the transmission efficiency for progressive image transmission over Additive White Gaussian Noise channel. Study Work and MATLAB simulation results show that, gradual increase in visual quality of reconstructed images and performance of the PAPR of OFDM for different SPIHT rates. Many papers are published for Image Transmission over OFDM system using different coding methods or using trigonometric transforms [4] or using Robust, Progressive [10], Optimal Images and comparing their performances using PAPR,PSNR ,MSE,BER etc. But none of them tried to transmit fused image over OFDM system. There are so many methods available for Image fusion like DCT based fusion,DWT based ,PCA and so many of them are available. With the introduction of Pyramid Transform in mid 80's, some sophisticated approaches

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began to emerge. People constitute that it would be better to conduct the fusion in transform domain. The fundamental idea is to construct the Pyramid Transform of the fused image from the Pyramid Transform of source images, then by taking IPT fused image is obtained. More recently with the development of wavelet theory of the nodes,researchers started to apply wavelet decomposition for image fusion [19].But Fusion is very vast subject much research is obtained in past years, as in [11] it can be concluded that, PCA & DCT based image fusion technique can be used for applications which does not require high quality & precision. Whereas DWT based fusion techniques provide us good quality fused images than PCA & DCT based techniques. Wavelet theory is very successful for this field. It is found that most of researchers have neglected image filtering and restoration which is must need of the image fusion. So researchers [13] proposed work integrates adaptive histogram equalization with DCT based technique to give better results than the older techniques. These integrated techniques have successfully reduced the limitations of the DCT based fusion technique. Here in this paper 2 step approach is used for image fusion by combining two fusions of different domains named Hybrid fusion.

III. PROPOSED ALGORITHM

A. Research Methodology

Following are the objectives of this research work:

1. To Fuse the images using DWT and PCA .
2. To transmit the fused image on Rayleigh, AWGN and Rician channels using different modulation techniques.
3. To compare the fused image transmission on the basis of various performance parameters.

B. Overall Architecture

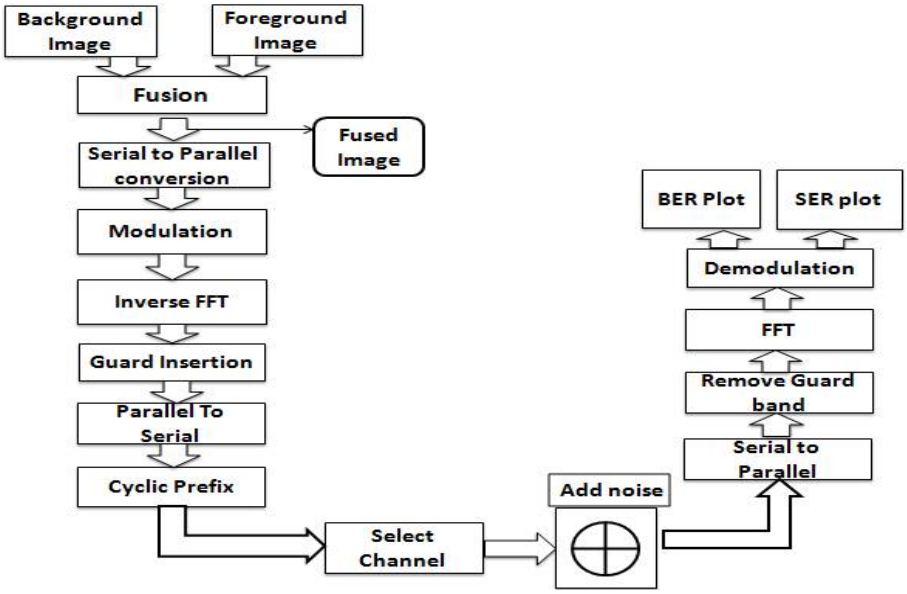

Fig.1. Overall Architecture

(Modulation scheme used: BPSK ,128 PSK,256 PSK)

(Channel scheme used: AWGN, Rayleigh, Rician)

Aim of the proposed algorithm is to transmit the fused image over OFDM system using various modulation schemes using different channels. The proposed algorithm is consists of three main steps.

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Step 1: Fusing the images using DWT and PCA

Here two images are taken named Background(IB) of Fig 3(b) and Foreground image(IF) shown in fig3(c) which act as input image to perform.The whole process of Hybrid Fusion is shown in flow diagram of fig1.Firstly DWT type of Fusion is applied on these image .In Discrete Wavelet transform fusion images are changed from basic domain to frequency domain IDWT is performed to reconstruct the final fused image.DWT provide good resolution in both time and frequency domain as well as high quality spectral content. The wavelet transform is similar to the Fourier transform with a completely different merit function. The main difference between these is Fourier transform decomposes the signal into sines and cosines, i.e. the functions localized in Fourier space; in contrast the wavelet transform uses functions that are localized in both the real and Fourier space.Wavelet transform is first applied on each source images to generate a fusion decision map based by using a set of fusion rules. Firstly consider two registered input apply DWT. Finally the fused image is obtained by taking the inverse wavelet transform. The discrete wavelets transform (DWT) allows the image breakdown in different kinds of coefficients preserving the image information. Such coefficients coming from different images can be appropriately combined to obtain new coefficients so that the information in the original images is collected appropriately. The fusion rule used in this paper is simply averaging the approximation coefficients and picks the detailed coefficients in each sub band with the largest magnitude. Now, the resultant fused image R1(as shown in fig.3(e)) is given to PCA block for second step fusion. Basically Principal Component Analysis is a technique used to emphasize variation and to bring out strong patterns in a data set. it is often used to make data easy to explore and visualize. it reduces the data down into its basic components, stripping away any unnecessary parts which further enhances the quality of image .Hence the resultant fused Image R2(as shown in 3(f)) is fed to next section for further processing. Their results are compared and are shown in table 1.

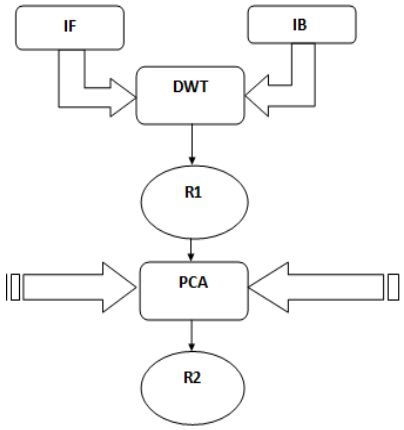

Fig.2.Flow diagram of Hybrid fusion

Step 2: To transmit the fused image on Rayleigh, AWGN and Rician channel using different modulation techniques.

a) Resultant fused Image R2 is converted from serial to parallel bits for applying Modulation. Each sub carrier is modulated with a conventional modulation schemes like BPSK,128 PSK,256 PSK.

b) This modulated signal is passed from IFFT block.FFT or IFFT is used to convert signal from time to frequency domain and vice versa. To reduce mathematical operation we use FFT instead of DFT Instead of using N modulators IFFT is used at transmitter side ,so we can perform IFFT on the signal to get the IDFT which is the samples of the modulated transmit signals. Therefore an FFT on the receiver side will act as a coherent demodulator for recovering the data symbols in serial order.Low rate data stream is always more advantageous to transmit as compare to high rate data stream.

c)Since the duration of each symbol is long ,It is feasible to insert a guard interval between the OFDM symbols, thus eliminating the intersymbol interference , the need for a pulse-shaping filter and it reduces the sensitivity to time synchronization problems. Length of the Guard interval must be greater than the delay spread of the channel.

TG > Delay

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d)Cyclic prefix :It means prefixing of symbol with the repetition of the end . Though receiver is supposed to discard the cyclic prefix but it is used in order to prevent multipath, So that channel estimation becomes easy.

e)Channel Selection: Three types of channel can be selected for transmission Rayleigh,AWGN,Rician.Each sub carrier is modulated with a conventional modulation schemes like BPSK,128 PSK,256 PSK.Each Modulation technique has its own advantages and disadvantages, but all of them can be used as per requirement.In this algorithm three types of channels are used for transmission of Image .

An Additive White Gaussian Noise (AWGN): It is basic noise model which is used to simulate the effect of many random processes that occur in nature. This noise is Additive because it is added in the signal from any source while transmitting but this noise is statistically independent of signal. This noise is White because of flat Power Spectral Density. Gaussian is used because of Gaussian distribution of noise samples.

Rayleigh fading is the form of fading that is often experienced in an environment where there is a large number of reflections present. These objects scatter the radio signals before it arrives at the receiver. In any terrestrial environment a radio signal will travel via a number of different paths from the transmitter to the receiver. Dependent upon the way in which these signals sum together, the signal will vary in strength. If all the signals are in phase with each other then they would all add together. However this is not normally the case, as some will be in phase and others out of phase, depending upon the various path lengths, and therefore some will tend to add to the overall signal, whereas others will subtract.

Rician Fading :It is a theoretical model for radio propagation peculiarly caused by partial cancellation of radio signals by itself. The signal arrives at the receiver by several different, and at least one of the paths is changing. Rician fading occurs when one of the paths, typically a line of sight signal, is much stronger than the others. In Rician fading, the amplitude gain is characterized by a Rician distribution. When there is no line of sight path exists between the OFDM transmitter and the receiver than the Rican Fading can be categorized by Rayleigh Fading .

Step 3: Compare performances on various parameters.

After demodulation original Image is retrieved and their performance is compared on parameters like BER and SER. The Bit Error Ratio Is The Number of bit errors divided by the total number of transferred bits during a time Interval .The Factors Effecting BER are Transmission Channel Noise, Synchronisation, Distortion ,Interference ,Attenuation. Multipath Fading etc.The disadvantage of conveying many bits per symbol is that the receiver has to distinguish many signal levels or symbols from each other, which may be difficult and cause bit errors in case of a poor phone line that suffers from low signal-to-noise ratio. In that case, a modem or network adapter may automatically choose a slower and more robust modulation scheme or line code, using fewer bits per symbol, in view to reduce the bit error rate. An optimal symbol set design takes into account channel bandwidth, desired information rate, noise characteristics of the receiver and the decoder complexity.

IV. SIMULATION RESULTS

The simulation studies first shows the results of hybrid fusion applied using Matlab R2013a and the results of fused image are compared on the basis of PSNR,MSE.As per the results of table 1 peak signal to noise ratio is less in case 1 when only DWT is applied. When the resultant image R1 is again fused by PCA the much improvement is shown by the image. Hence it is concluded that 2-step approach is much better than using single method of fusion.MSE that is mean square error is reduced to its half. After fusion the image is transmitted over OFDM system using different fading channels and modulations techniques .One of them is shown with and graphs below.

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Table I. Performance comparison of resultant fused images

	After DWT(R1)	After PCA(R2)
PSNR	20.48	23.95
MSE	521.70	261.76

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Fig 3. a) Original colored image b)Image converted in grayscale c)Background image d)Foreground image

e) Resultant fused image R1 using DWT type of fusion f) Resultant Image R2 after PCA fusion

Case I :AWGN Channel

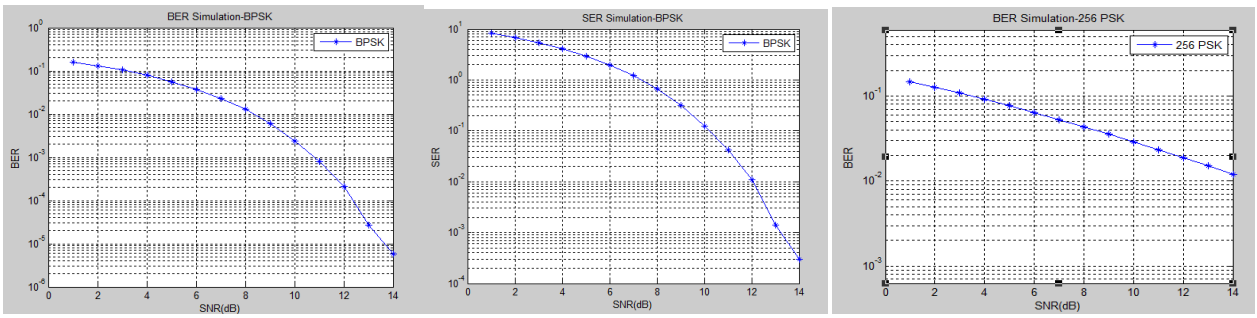

Fig.6 a)BER result of BPSK b)SER results of BPSK c)BER results of 256 PSK

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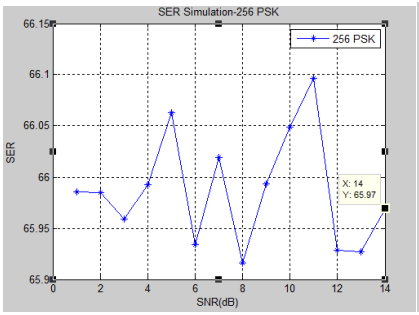
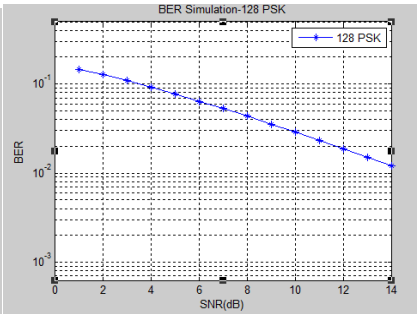
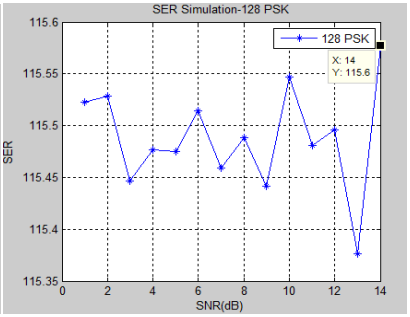
It can be seen here in fig 6 as BER and SER graph of BPSK abruptly reaches to lower points which concludes that error reduces with the increase of signal to noise ratio.But in case of 256 PSK ,curve is straight bending towards lower end with increase of SNR.It means as value of SNR increase bit error rate is decreasing but this process is slow as compare to BPSK.



d)SER results of 256 PSK



e)BER results of 128 PSK



f)SER results of 128 PSK over AWGN

Table II.Comparison of BER vs.SNR over AWGN channel

SNR (db)	BPSK (BER)	128 PSK (BER)	256 PSK (BER)
0	0	0	0
2	0.1315	0.1267	0.1267
4	0.07914	0.09191	0.09191
6	0.03749	0.06418	0.06418
8	0.01279	0.04347	0.04347
10	0.002417	0.02878	0.02878
12	0.000211	0.01875	0.01875

Table III.Comparison of SER vs SNR over AWGN channel

SNR(db)	BPSK (SER)	128 PSK (SER)	256PSK (SER)
0	0	0	0
2	6.84	115.528	65.98
4	4.115	115.476	65.99
6	1.949	115.514	65.93
8	0.6653	115.488	65.92
10	0.6653	115.547	66.05
12	0.1257	115.496	65.93

CASE II:Rician Channel

Table IV:Comparison of BER vs SNR over RICIAN channel

SNR (db)	BPSK (BER)	128 PSK (BER)	256 PSK (BER)
0	0	0	0
2	0.1317	0.1263	0.1263
4	0.0792	0.09191	0.09191
6	0.0375	0.06418	0.06418
8	0.0123	0.04347	0.04347
10	0.00252	0.02878	0.02878
12	0.00022	0.01875	0.01875

Table V:Comparison of SER vs SNR over RICIAN channel

SNR (db)	BPSK (SER)	128 PSK (SER)	256 PSK (SER)
0	0	0	0
2	6.848	115.63	66.020
4	4.121	115.37	65.964
6	1.955	115.54	65.973
8	0.6436	115.55	65.975
10	0.131	115.51	65.892
12	0.115	115.45	65.975

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CASE III:Rayleigh Channel

Table VI:Comparison of BER vs SNR over RAYLEIGH channel

SNR (db)	BPSK (BER)	128 PSK (BER)	256 PSK (BER)
0	0	0	0
2	0.1307	0.1267	0.1267
4	0.0781	0.0919	0.0919
6	0.0375	0.0641	0.0641
8	0.0124	0.0434	0.0434
10	0.0024	0.0287	0.0287
12	0.00023	0.0187	0.0187

Table VII:Comparison of SER vs SNR over RAYLEIGH channel

SNR (db)	BPSK (SER)	128 PSK (SER)	256 PSK (SER)
0	0	0	0
2	6.796	115.5	65.89
4	4.092	115.5	66.03
6	1.962	115.4	65.88
8	0.6465	115.5	65.95
10	0.1261	115.6	65.94
12	0.012	115.5	65.98

IV.CONCLUSION AND FUTURE WORK

This paper performs the survey of Hybrid fusion technique and then implementing its resultant fused image for transmission over noisy channels. The simulation results showed that the proposed algorithm performs better with the fused image transmission. As the value of SNR increases value of BER reduces as seen in all the three modulation techniques irrespective of channels,means no. of error prone bits reduces by total no. of bits transmitted.But as shown in Table II,IV,VI ,BER almost remains same for 128 PSK and 256 PSK irrespective of channels.so,it concludes that channels make no as such difference in the values of BER and SER rates.As shown in Fig.6 a) in a case of BPSK the graph abruptly reaches to lowest points. It means overall performance of BPSK is much better than other modulation techniques. That means modulation techniques of lower order is better to use in communication system if spectral efficiency is not taken in an account.

In case of SER ,as SNR increases rapid but minor fluctuation had taken place as shown in graph. The curves of Symbol error rate are more fluctuating but its range is limited . The received image is much better in quality and more precise as compare to number of input image .In future we can increase the number of modulation techniques and can implement this over various Medical as well Remote sensing application to achieve vast results as per requirement.

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BIOGRAPHY

Taranjit Kaur is a Research Asistant and pursuing her M.tech in the Electronics and Communication Department of DAVIET under Punjab Technical University (PUNJAB). She received her B.TECH (ECE) degree in 2012 from CT Institute Of Technology,Punjab, India. Her research interests is focused mainly for Communication Field.